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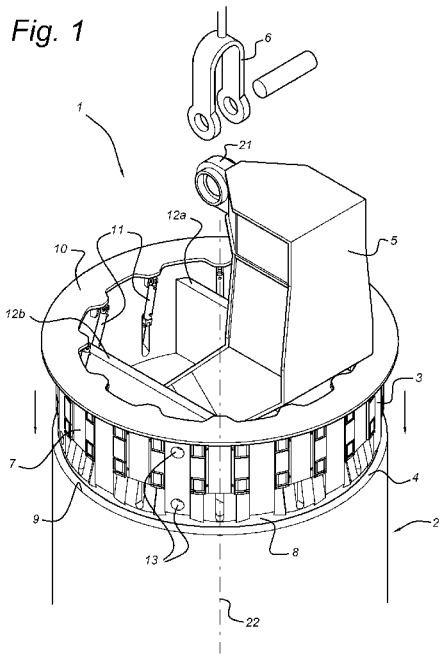
(54) Title: PILE UPENDING DEVICE

(57) Abstract: Pile upending device (1) for large diameter tubular elements (2), the device comprising;- an annular base ring (3) for extending along substantially the entire circumference (4) of the tubular element, - a central lifting arm (5) for coupling the pile upending device to a hoisting element (6), which lifting arm is hingeably coupled with the base ring, - a number of wedge assemblies (7) disposed along the outside circumference (8) of the base ring for facing the inside surface (9) of the tubular element and frictional engagement with the tubular element.

Fig. 1



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Pile upending device

Background

The present disclosure relates to a pile upending device for large diameter tubular elements.

GB2486200 (A) relates to an apparatus for handling tubular members for use in offshore anchoring systems. GB2486200 describes, there is a trend towards the use of larger tubular metal piles in offshore anchoring systems, especially for offshore wind turbine installations. As pile size increases the ratio of diameter to wall thickness usually also increases. This leads to greater flexibility of the pile and a consequent need for more careful handling as damage to the pile is to be avoided. It is an object of GB2486200 to provide improved apparatus for handling tubular members. Therefore, there is provided an apparatus for handling tubular members comprising at least one gripping head, the gripping head comprising a pair of rollers and means for urging the rollers towards each other to grip a wall of the tubular member. Use of rollers to grip the wall of a tubular member reduces the risk of damaging the wall as compared to solid gripping elements.

There is room for improvement in connection with pile upending device for large diameter tubular elements in that load to the pile, specifically the wall thereof, is reduced.

Summary

It may be desirable to provide a pile upending device for large diameter tubular elements wherein the load to the pile, specifically the wall thereof, is reduced.

It may further be desirable to improve a known pile upending device for large diameter tubular elements in that a problem associated therewith may be partly solved.

It may further be desirable to provide an alternative pile upending device for large diameter tubular elements.

According to a first aspect this is realized with a pile upending device for large diameter tubular elements, the device comprising;

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- an annular base ring for extending along the entire circumference of the tubular element,
- a central lifting arm for coupling the pile upending device to a hoisting element, which lifting arm is hingeably coupled with the base ring,
- a number of wedge assemblies disposed along an outside circumference of the base ring for facing an inside surface of the tubular element and frictional engagement with the tubular element, wherein the central lifting arm is moveably disposed between a pair of plate members within the annular base ring.

The annular base ring may be centrally open which may enable the central arrangement of the lifting arm and reduces weight of the upending device. The lifting arm being hingeably coupled with the base ring may enable reduction of bending moments between the pile upending device and the tubular element during upending because the lifting arm being hingeable may then enable to align the hoisting point with the contact area between the pile upending device and the tubular element. Aligning the hoisting point with the contact area means that the hoisting force may be aligned with the contact area. The number of wedge assemblies may provide an even engagement of the tubular element and may avoid load concentration.

Large diameter here may mean tubular elements for use in offshore anchoring systems, the diameter of such a tubular element being e.g. between 3 and 7 meters. It is noted that the present disclosure does not relate to conductor strings which typically have smaller diameters such as 1 meter or less.

In an embodiment of the pile upending device, the diameter of the outside circumference of the base ring may exceed 3 meters, may exceed 4 meters, may be between 4 and 7 meters.

In an embodiment of the pile upending device, the number of wedge assemblies extends in total over more than 50 % of the outside circumference of the base ring. This may provide an even engagement of the tubular element and avoid load concentration.

In an embodiment of the pile upending device, the lifting arm may be hingeable around a lifting arm rotation axis, and the rotation axis extends in a plane which is

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defined by the number of wedge assemblies such that in use the rotation axis imaginary crosses an annular contact area between the pile upending device and the tubular element. This may enable reduction of bending moments between the pile upending device and the tubular element during upending.

In an embodiment of the pile upending device, the rotation axis may extend through the centre of the base ring. This may centre the hoisting force with respect to the pipe upending device and may enable reduction of bending moments between the pile upending device and the tubular element during upending.

In an embodiment, the pile upending device may comprise a lifting arm driving device for angular displacement of the lifting arm with respect to the base ring. This may enable control or reducing of the bending moment on the tubular element. In addition, this may facilitate handling of the pile upending device and in particular inserting the pile upending device into the tubular element.

In an embodiment, the pile upending device may comprise a base ring driving device for centring the base ring with respect to the tubular element.

In an embodiment of the pile upending device, the base ring driving device may comprise a number of drive units for contacting the inside surface of the tubular element.

In an embodiment of the pile upending device, a wedge assembly, or each wedge assembly, of the number of wedge assemblies, may comprise a wedge driving device.

In an embodiment of the pile upending, the wedge assembly, of the number of wedge assemblies, may comprise a wedge surface which is moveably arranged and moveable between a wedge inner position wherein the pile upending device can be introduced or taken out of the tubular element, and a wedge outer position wherein the wedge surface contacts the tubular element for friction coupling between the pile upending device and the tubular element.

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In an embodiment of the pile upending, the wedge surface is moveable over a relative long stroke.

The disclosure further relates to an assembly of a tubular element and a pile upending device according to the disclosure, which pile upending device is friction coupled with the tubular element.

In an embodiment of the assembly, the pile upending device may be friction coupled with a conical section of the tubular element.

The disclosure further relates to a method for upending a large diameter tubular element, comprising the steps;

- providing a pile upending device as described,
- introducing the device in a top end of a horizontal tubular element while controlling the angular position of the base ring with respect to the lifting arm,
- centring the pile upending device with respect to the tubular element,
- extending the wedge assemblies for frictional engagement with the tubular element,
- upending the tubular element at a lift point on the lifting arm,
- lifting the tubular element.

The disclosure further relates to a device comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

The disclsoure further relates to a method comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

The various aspects discussed can be combined in order to provide additional advantageous advantages.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

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In the claims which follow and in the preceding description of the disclosure, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of this disclosure.

It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the spirit and scope of the invention.

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Description of the drawings

The disclosure will be further elucidated referring to a preferred embodiment of a pile upending device shown in the drawing wherein shown in:

Fig. 1 in perspective view a pile upending device;

fig. 2 the pile upending device according to fig. 1 in a different position;

fig. 3 a detail of a wedge assembly of the pile upending device according to fig. 1;

fig. 4 a cross sectional side view of a wedge assembly of the pile upending device according to fig. 1;

fig. 5 a side view, partly cross sectional, of the pile upending device according to fig. 1; and fig 6 a detail of base ring driving device of the pile upending device according to fig. 1.

Detailed description of embodiments

Fig. 1 shows in perspective view a pile upending device 1. The pile upending device 1 is suitable for handling, in particular upending, large diameter tubular elements 2. The pile upending device 1 comprises an annular base ring 3. The shown base ring 3 is substantially centrally open. The base ring 3 extends along the entire circumference 4 of the tubular element 2. The diameter of the outside circumference of the base ring 3 exceeds 3 meters, preferably exceeds 4 meters, more preferably is between 4 and 7 meters.

The pile upending device 1 comprises a central lifting arm 5. The central lifting arm 5 is suitable for coupling the pile upending device 1 via a lift point 21 to a hoisting element 6. The lifting arm 5 is suitable to transfer forces required for upending and lifting the pile, here the tubular element 2 which may easily weigh up to one thousand tons and more. The lifting arm is 5 is hingeably coupled with the base ring 3. The forces required for upending and lifting the tubular element 2 are transferred through the base ring 3 onto the tubular element 2.

The pile upending device 1 comprises a number of wedge assemblies 7 which may be suitable for frictional engagement with the tubular element 2, specifically the wall thereof. The wedge assemblies 7 are evenly disposed along the outside circumference 8 of the base ring 3 which may result in even distribution of forces.

Other arrangements of the wedge assemblies 7 are conceivable. The wedge assemblies 7 face radial outwards from the base ring 3 such that in use the wedge assemblies 7 face the inside surface 9 of the tubular element 2. The number of wedge assemblies 7 extend in total over more than 50 %, here about 70%, of the outside circumference of the base ring 3.

Fig. 1 shows the pile upending device 1 above the tubular element 2 shortly before engaging the tubular element 2 to form an assembly of the tubular element 2 and the pile upending device 1 wherein the pile upending device 1 is friction coupled with the tubular element 2. The central axis of the base ring 3 is about aligned with the longitudinal axis 22 of the tubular element 2.

The pile upending device 1 here engages a cylindrical top section of the tubular element 2. It is however conceivable that the pile upending device 1 engages a conical section (not shown) of the tubular element 2 so that the pile upending device 1 is friction coupled with the conical section of the tubular element 2.

A top plate 10 contributes strength to the pile upending device 1 and, in use, abuts with its lower face the rim 4 of the tubular element 2 for facilitating alignment of the pile upending device 1 and the tubular element.

Fig. 2 shows the pile upending device 1 of fig. 1 in a different position. The base ring 3 is rotated over about 90° and the central axis of the base ring 3 extends horizontally.

Fig. 3 shows a detail of the wedge assembly 7 of the pile upending device 1. The moveable wedge section is provided with a number, here two, button plates 15. A button plate 15 has in this case four button rows 14 provided with a series of buttons to provide frictional engagement. The botton plates 15 and specifically the button rows thereof form in total, in use, the annular contact area between the pile upending device 1 and the tubular element 2.A spacer 16 is arranged behind a button plate 15 to adjust its radial position to adapt the upending device 1 to a desired diameter.

Fig. 4 depicts a cross sectional side view of the wedge assembly 7 of the pile upending device 1. The wedge assembly 7, of the number of wedge assemblies, comprises a wedge surface 17. The wedge assembly moving portion 7a is moveably arranged and moveable between a wedge inner position (shown) wherein the pile upending device 1 can be introduced or taken out a tubular element 2, and a wedge outer position (not

shown) wherein the wedge surface contacts the tubular element 2 for friction coupling between the pile upending device 1 and the tubular element 2. The wedge assembly 7, specifically the wedge assembly moving portion 7a, may be radially moveable over a relative long stroke, like 10 cm.

The two mating wedge surfaces 17, 20 provide a radial outward movement of the button plates 15 when the wedge driving device, here a hydraulic cylinder 11, is extended. The two mating wedge surfaces 17, 20 also provide the wedge effect once the button plates 15 are in friction coupling with tubular element 2. The wedge surface 20 is part of the wedge assembly stationary portion 7b. Here, each wedge assembly 7, of the number of wedge assemblies, comprises a hydraulic cylinder 11.

Fig. 5 shows a side view, partly cross sectional, of the pile upending device 1. The pile upending device 1 comprising a lifting arm driving device, here a hydraulic cylinder 18, for angular displacement of the lifting arm 5 with respect to the base ring 3. The lifting arm 5 is rotatably disposed around axis of rotation 19. The lifting arm 5 is disposed between a pair of plate members 12a, 12b which enforce the base ring 3.

The rotation axis 19 extends in a plane which is defined by the number of wedge assemblies 7 such that in use the rotation axis 19 imaginary crosses the annular contact area between the pile upending device 1 and the tubular element 2. As shown, the rotation axis 19 extends through the centre of the base ring 3.

Fig 6 shows a detail of a base ring driving device 13 of the pile upending device. The base ring driving device 1 is suitable for centring the base ring 3 with respect to the tubular element 2 prior to friction coupling the pile upending device 1 with the tubular element 2. The base ring driving device 13 comprises a number of drive units for contacting the inside surface 9 of the tubular element 2.

During use of the pile upending device 1 following method for upending a large diameter tubular element 2 can be executed. The method comprising the steps;

– providing a pile upending device 1,

- introducing the device 1 in a top end of a horizontal tubular element 2 while controlling the angular position of the base ring 3 with respect to the lifting arm 5,
- centring the pile upending device 1 with respect to the tubular element 2,
- extending the wedge assemblies 7 for frictional engagement with the tubular element 2,
- upending the tubular element 2 at a lift point 21 on the lifting arm 5,
- lifting the tubular element 2.

It will also be obvious after the above description and drawings are included to illustrate some embodiments, and not to limit the scope of protection. Starting from this disclosure, many more embodiments will be evident to a skilled person which are within the scope of protection and the essence of this invention and which are obvious combinations of prior art techniques and the current disclosure.

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Claims

1. Pile upending device (1) for large diameter tubular elements (2), the device comprising;
   - an annular base ring (3) for extending along the entire circumference (4) of the tubular element,
   - a central lifting arm (5) for coupling the pile upending device to a hoisting element (6), which lifting arm is hingeably coupled with the base ring,
   - a number of wedge assemblies (7) disposed along an outside circumference (8) of the base ring for facing an inside surface (9) of the tubular element and frictional engagement with the tubular element, wherein the central lifting arm is moveably disposed between a pair of plate members within the annular base ring.

2. Pile upending device according to claim 1, wherein the diameter of the outside circumference of the base ring exceeds 3 meters.

3. Pile upending device according to a preceding claim, wherein the base ring is centrally open.

4. Pile upending device according to a preceding claim, wherein the number of wedge assemblies extend in total over more than 50 % of the outside circumference of the base ring.

5. Pile upending device according to a preceding claim, wherein the lifting arm (5) is hingeable around a lifting arm rotation axis (19), and the rotation axis (19) extends in a plane which is defined by the number of wedge assemblies (7) such that in use the rotation axis (19) imaginary crosses an annular contact area between the pile upending device and the tubular element (2).

6. Pile upending device according to claim 5, wherein the rotation axis extends through the centre of the base ring (3).

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7. Pile upending device according to a preceding claim, comprising a lifting arm driving device for angular displacement of the lifting arm with respect to the base ring.

8. Pile upending device according to a preceding claim, comprising a base ring driving device for centring the base ring with respect to the tubular element.

9. Pile upending device according to claim 8, wherein the base ring driving device comprises a number of drive units for contacting the inside surface of the tubular element.

10. Pile upending device according to a preceding claim, wherein a wedge assembly, of the number of wedge assemblies, comprises a wedge driving device.

11. Pile upending device according to a preceding claim, wherein the wedge assembly, of the number of wedge assemblies, comprises a wedge surface which is moveably arranged and moveable between a wedge inner position wherein the pile upending device can be introduced or taken out of the tubular element, and a wedge outer position wherein the wedge surface contacts the tubular element for friction coupling between the pile upending device and the tubular element.

12. Pile upending device according to a preceding claim, wherein the wedge surface is moveable over a relative long stroke.

13. Assembly of a tubular element and a pile upending device according to a preceding claim, wherein the pile upending device is friction coupled with the tubular element.

14. Assembly according to claim 13, wherein the pile upending device is friction coupled with a conical section of the tubular element.

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15. Method for upending a large diameter tubular element, comprising the steps;

- providing a pile upending device according to a preceding claim,
- introducing the device in a top end of a horizontal tubular element while controlling an angular position of the base ring with respect to the lifting arm,
- centring the pile upending device with respect to the tubular element,
- extending the wedge assemblies for frictional engagement with the tubular element,
- upending the tubular element at a lift point on the lifting arm, and
- lifting the tubular element.

Fig. 1

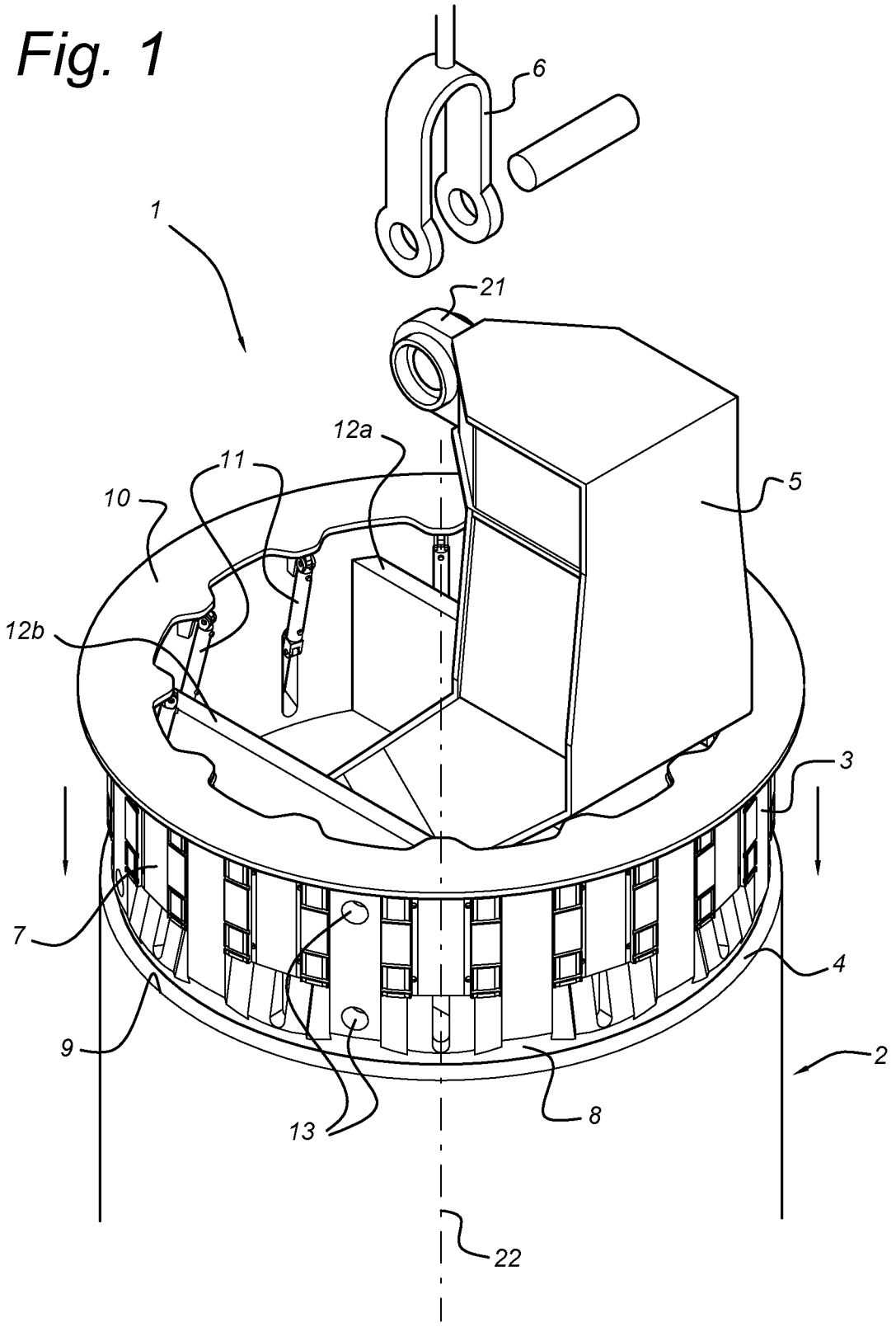

Fig. 2

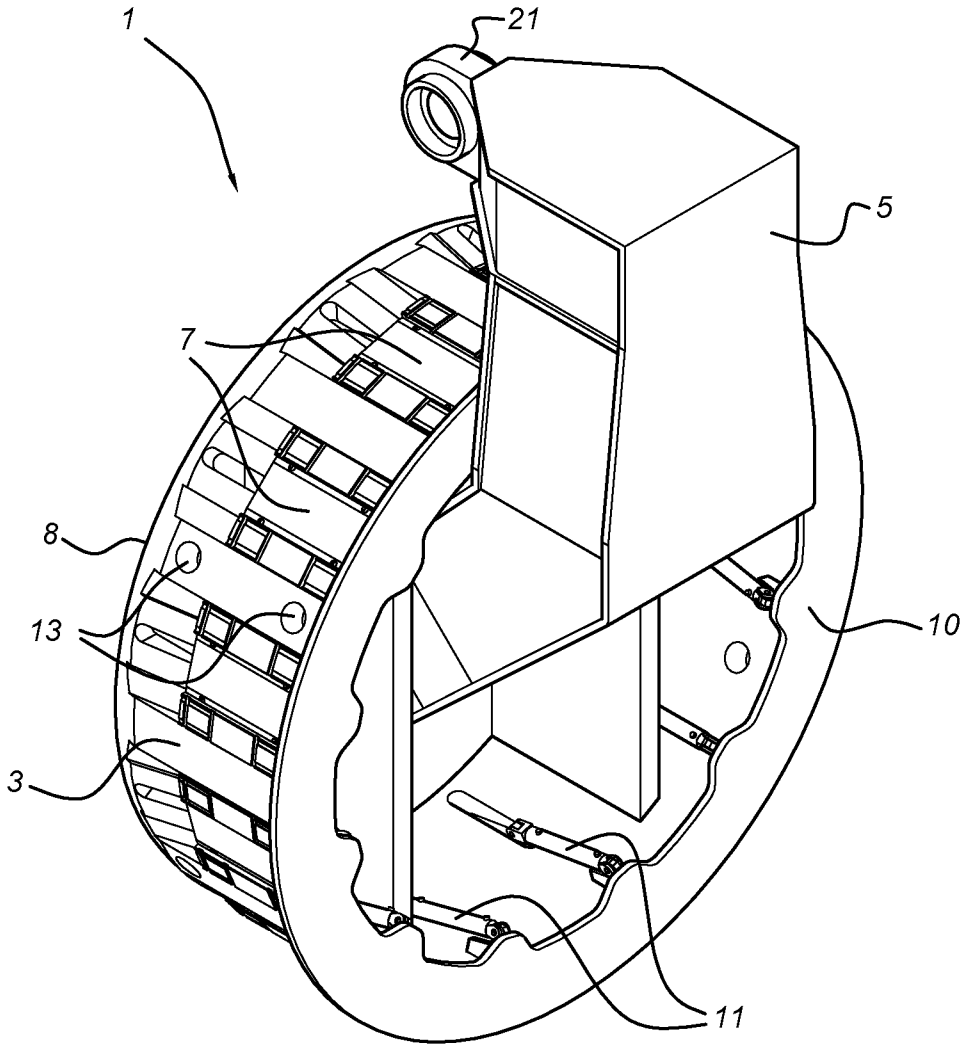

Fig 3

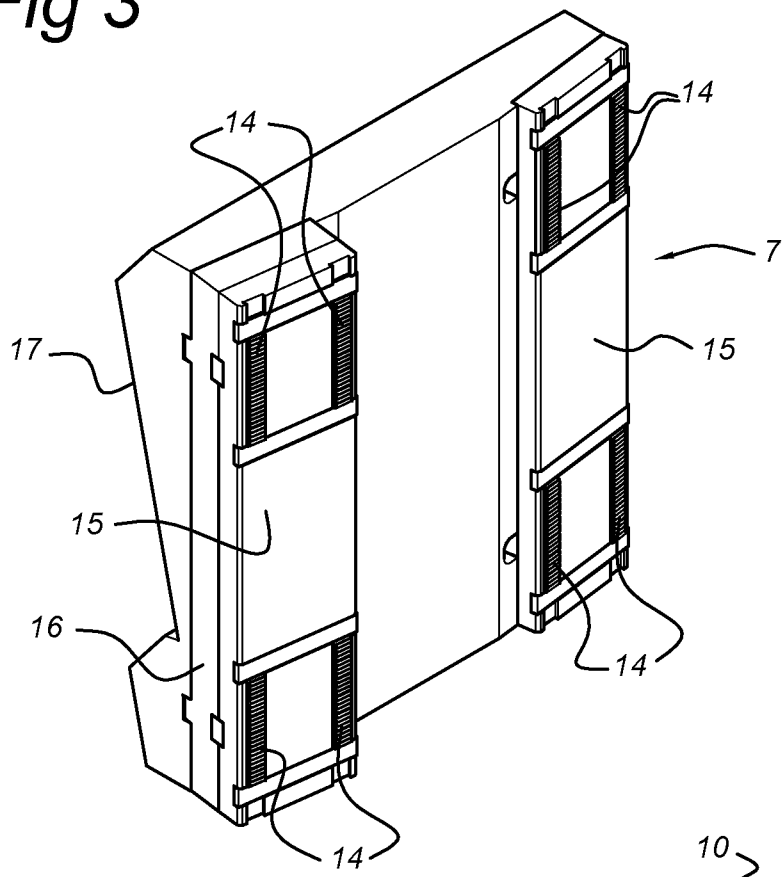

Fig 4

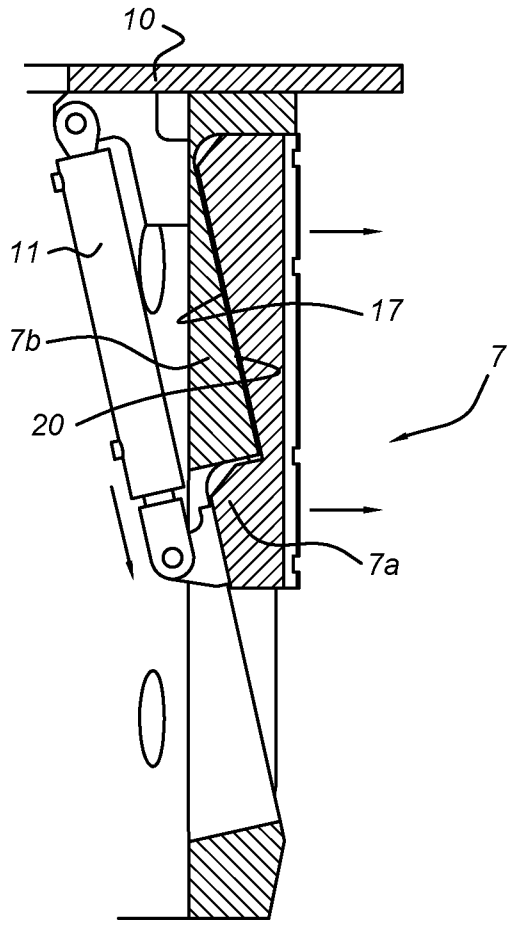

Fig 5

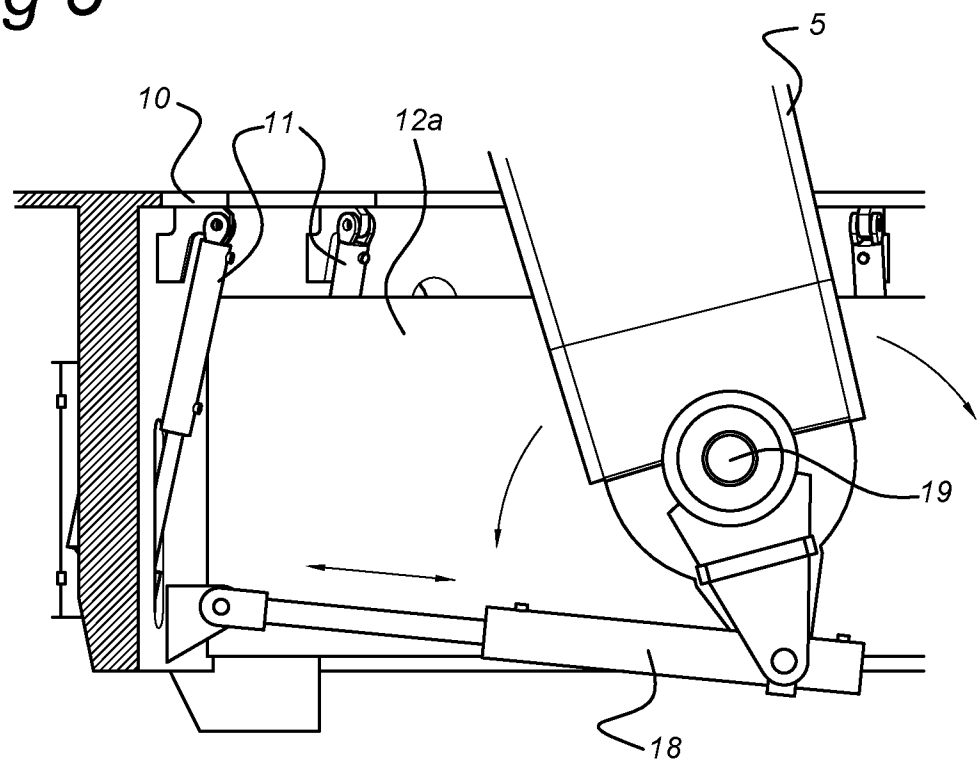

Fig 6